IEEE 802.15
Wireless Personal Area Networks

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Title	**First Test Scenario: MAC Simulation Parameters and Performance Measurements.**		
Date Submitted	May 29, 2000		
Source	Nada Golmie NIST 100 Bureau Dr. Stop 8920 Gaithersburg, MD 20899	Voice: Fax: E-mail:	(301) 975-4190 (301) 590-0932 nada.golmie@nist.gov
Re:			
Abstract	This document describes the MAC Parameters for the first simulated experiment.		
Purpose	This document is distributed to members of TG2 in order to provide a basis for the May 30, 2000 teleconference discussion.		
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First Test Scenario: MAC Simulation Parameters and Performance Measurements

The objective of this first test scenario is to validate the simulation results obtained against the experimental and analytical results. This document describes the simulated test scenario consisting of three parts: the traffic model, the parameters of the simulation and the output measurements.

1. Traffic Models

The traffic model generates packets of information passed from the upper sub-layer of the data-link layer to the MAC layer. They contain headers that upper layers may have chosen to attach to the message. Since at this point we are only concerned about the impact of the MAC layer on the traffic generated, we will not model the details of the higher layer applications. We will limit the modeling of the application to the generation of packets (including appropriate headers). We assume that the MAC layer will add further fields to the message and may segment it into smaller frames.

2. Performance Metrics

There are many output measurements that can be recorded. For this test scenario we will use the performance metrics that was presented in IEEE 802.15-00/103r0.

1. **Access Delay:** measure the time it takes to transmit a packet from the time it is passed to the MAC layer until it is successfully received at the destination (MAC layer). It is assumed that the whole message is generated instantaneously, while any segmentation/reassembly processing time that may be required is assumed to be negligible.

1.1 Average Access Delay sum of all access delays divided by the simulation time. (Units = milliseconds)
1.2 Coefficient of delay variance: access delay standard deviation divided by the average access delay.
1.3 Access delay probability distribution function (95th, 99th percentiles).

2. **Throughput.** A measure, in bits/sec of the *successful* traffic being transmitted including overhead of the MAC or PHY (e.g. FEC, HEC, data types).

3. **Goodput:** A measure, in bits/sec of the *successful* traffic being transmitted excluding overhead of the MAC or PHY.

4. **Packet Loss**: measures the number of packets discarded at the MAC layer due to errors in the bit stream. This measure is conducted after performing error correction (FEC, HEC). The packet loss represents the number of packets lost divided by the total number of packets sent during the simulation time

3. Simulation Parameters

There are two sets of simulation parameters pertaining to the Bluetooth and 802.11 devices. Our goal in this first test scenario, will be focused on measuring the impact of 802.11 on Bluetooth devices. Therefore 802.11 devices constitute the interference signal.
We envision two approaches to modeling interference at the MAC layer. This is accomplished by interfacing the MAC layer simulations to an RF model that captures the effects of interference and the channel characteristics. The second means of accomplishing the same goal is to build a BER model that captures the number of errors and their distribution in the packet.
Most likely, the second approach will follow after we are able to analyze traces of bit streams. The parameters presented here are used in the MAC layer model. The interface parameters and the RF parameters will be described in a subsequent document.

Traffic Type	**FTP Application**
File Interarrival time (seconds)	fixed
File Size (bytes)	fixed
Topology	
Number of Bluetooth devices	2 (1 master, 1 slave) asymmetric traffic from master to slave
Number of 802.11 devices	2 (1 connection between AP and PC)
Distance between devices	2/10 meters
Bluetooth (MAC) Parameters	
Baseband Packet Encapsulation	DM5
Mode of Operation	Connection
Processing delay (at transmitter and receiver including segmentation and reassembly)	0 ms
802.11 (MAC) Parameters	
Rate (Mbits/s)	11
PHY Type	Direct Sequence
Retry Limits (short, long counter)	4
Fragmentation	None
Access Mode	DCF (contention based)
CW max	
CW min	
DIFS	
SIFS	
RTS/CTS	Not used
Power Save	N/A
Processing delay (at transmitter and receiver including segmentation and reassembly)	0 ms
Length of Simulation Run	100 seconds, 1000 seconds
Length of Run Prior to Gathering Statistics	5% of simulated time

Table 1 : Simulation parameters for the validation scenarion.

4. Measurement Format

The results will consist of performance results for each protocol specifications (IEEE 802.11, and Bluetooth) in:

(a) a clean environment (without interference)

(b) a coexistence environment (with the interference effect).

The results will consist of the (i) mean access delay (ii) throughput, iii) goodput, iv) coefficient of delay variation, and v) packet loss plotted against the offered load for the default parameters shown in Table 1.

In order to compare the results from (a) and (b), we compute the percentage of the difference (i.e. the difference between (a) and (b) divided by the results from (a)) and conduct a one tailed-test on the significance of the difference (see [1]).

5. REFERENCES

1. N. Golmie, "Performance Metrics of MAC Coexistence Evaluation," IEEE Working Group Contribution, IEEE 802.15-00/103r1, May 2000, Seattle, WA.